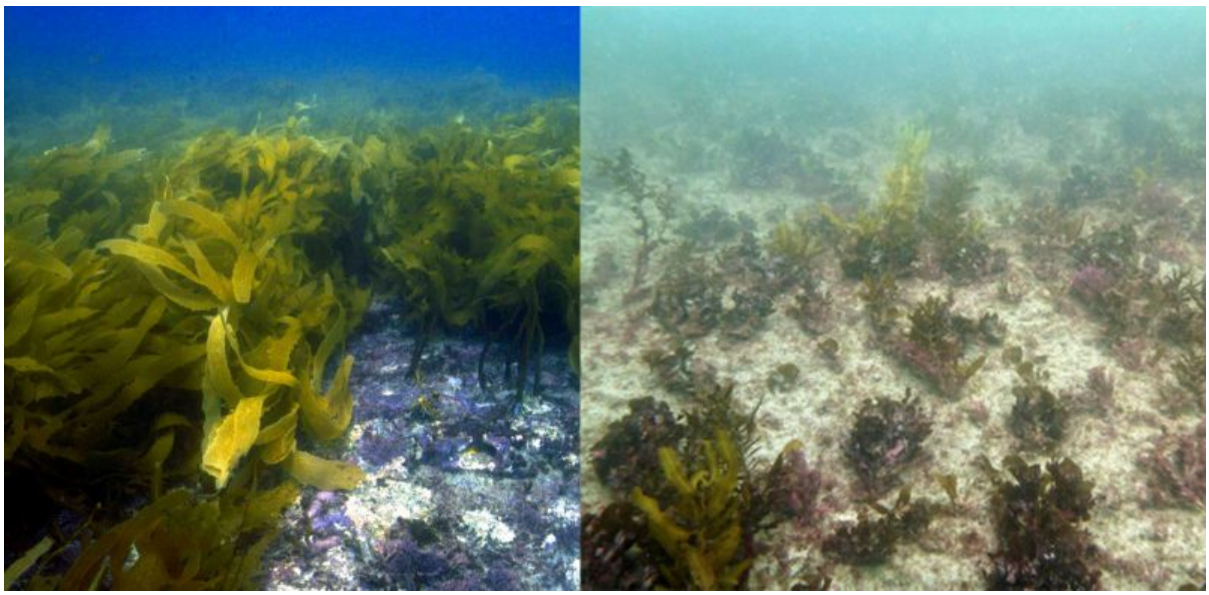
On kelp, mangroves, peat and coral - Four environmental tragedies in 2016.

The disruption of ecosystems arising from climate-driven changes are expected to have profound ecological, social, and economic implications. Already there is strong evidence of rapid climate-driven shifts in Australian marine and terrestrial ecosystems. The lengthy period of temperature increases are resulting in the death of kelp forests on temperate reefs in Western Australia, the death of coastal mangroves in the Gulf of Carpentaria, unprecedented fires in the highlands of Tasmania and the major death of coral in Queensland and Western Australia.

Kelp death and the loss of temperate reefs

The Great Southern Reef is a system of rocky reefs covered by kelp forests that runs for 2,300km along the south coast of Australia, extending past Sydney on the east coast, down to Tasmania and back up to Kalbarri on the west coast. It supports most of the nation's fisheries, including the lucrative rock lobster and abalone fisheries, and is worth about $10bn to the Australian economy. It is also a global biodiversity hotspot.

A hundred kilometres of kelp forests off the western coast of Australia were wiped out by a marine heatwave between 2010 and 2013 which caused the ocean temperature to increase by about 2 degrees C. About 90% of the forests that make up the north-western tip of the Great Southern Reef disappeared over the period, replaced by seaweed turfs, corals, and coral fish usually found in tropical and subtropical waters. The tropicalisation has suppressed the recovery of the kelp forest and resulted in the functional extinction of 370 sq km of rocky cool-climate reefs.



Rocky reefs off Australia's western coast before (left) and after (right) a 2011 marine heatwave. Image: T. Wernberg

The area was then rapidly colonised by turf-forming seaweeds and bottom-grazing tropical herbivores, such as rabbitfish and parrotfish, which stopped the kelp from regrowing.

In the event of continued warming, further death of kelp is anticipated. Retraction of the functional temperate reef to the Southern tip of the continent will have devastating impacts on marine wildlife with significant implications on Australia's fish stocks.

https://www.theguardian.com/environment/2016/jul/07/australias-vast-kelp-forests-devastated-by-marine-heatwave-study-reveals

http://science.sciencemag.org/content/353/6295/169

The loss of mangroves in the Gulf of Carpentaria
Unusually warm water temperatures have caused the worst mangrove die-off in recorded history, stretching along 700 km of Australia's Gulf of Carpentaria. Scientists from James Cook University calculated dead mangroves now covered a combined area of 7,000 hectares, the worst mangrove mass die-off seen anywhere in the world. This has occurred across the whole southern gulf in a single month.

Aerial footage of mangrove die-off in the Gulf of Carpentaria in mid 2016. Photograph: Professor Norm Duke/James Cook University

The devastated mangrove forests played an essential role in the region's ecosystem. As water from rivers and floodplains runs into the ocean, mangroves filter a lot of sediment, and protect coral reefs and seagrass meadows. That level of protection will be lost in the areas affected by die-off. This problem will get worse over the coming years as the roots of the dead plants rot and those sediments become destabilised. This will threaten the near-shore habitats of seagrass and coral and the marine life that depends on this habitat. The mangroves were nurseries for many fish species so there are potential adverse implications on the fishing industry.

The mangroves also protect the shoreline and coastal ecosystems from storms and storm surges. Absorbing waves that hit the coast helps limit the impact of storms and rising sea levels.
Mangroves are good at adapting, but not to such severe widespread changes that occurred so quickly. How they would recover over the coming years is unclear. It is possible that some areas could transition completely away from being mangrove-dominated, and become salt pans – flat, unvegetated areas of shoreline covered in salt. This pristine wilderness area may be irreversibly destroyed.

https://www.theguardian.com/environment/2016/jul/11/massive-mangrove-die-off-on-gulf-of-carpentaria-worst-in-the-world-says-expert

Fires in Tasmanian wilderness
In 2016 there was a large series of bushfires in Tasmania which started in January and continued into February, with considerable damage to fire sensitive areas in the Central Highlands, West Coast and South-West regions. Over the first 20 days of the fires, there were at least 70 separate blazes. Although not significant in terms of property loss, the impact on the Central Highlands and the World Heritage Area lands has been catastrophic. Modelling by the University of Tasmania postdoctoral fellow Dr Grant Williamson, revealed that more than 14 per cent of the 97,000 ha burnt by the fires were in World Heritage Areas and another 25 per cent in conservation or national park areas.

Cushion plant and pencil pine, Mackenzie fire, Tasmania. Rob Blakers - http://www.greenlivingpedia.org/Image:2016_Tasmanian_bushfire_MG_0136.jpg

The fires are extremely destructive for two main reasons. First, the fires are threatening vegetation that is unique to Tasmania, including iconic alpine species such as the Pencil Pine and cushion plants, as well as temperate rainforests. The lack of inherent dispersal processes for some of the endemic flora species is a major problem for regeneration. Second, the fires burnt large areas of organic soils upon which the unique Tasmanian vegetation depends. It is extremely unlikely that burnt areas with the endemic alpine flora will ever fully recover given the slow growth of these species and the slow accumulation of peat soils which takes thousands of years. The change to more flammable vegetation will result in an increased risk of subsequent fires

The 2015/16 fire season was truly extraordinary because of the sheer number of fires caused by lightning strikes, their duration, and erratic and destructive behaviour. The root cause of the has been the record-breaking dry spring and the largely rain-free and consistently warm summer, which has left fuels and peat soils bone dry.

Under a warming climate the ecological niche of much of the unique Tasmanian vegetation is shrinking and will in all likelihood be lost. More fundamentally, the loss of vegetation that takes thousands of years to recover from disturbance is a warning shot that climate change has the potential to result in bushfires that will impact food security, water quality and critical infrastructure.

http://theconversation.com/fires-in-tasmanias-ancient-forests-are-a-warning-for-all-of-us-53806

The major death of coral in the northern Great Barrier Reef

Two-thirds of the corals in the northern part of the Great Barrier Reef have died in the reef's worst-ever bleaching event in 2016, according to underwater surveys.

On some reefs in the north, nearly all the corals have died. However the impact of bleaching is less on reefs in the central and southern regions (around Cairns and Townsville and southwards). These reefs were much less affected, and are now recovering.

Heat stress from record high summer temperatures damages the microscopic algae (zooxanthellae) that live in the tissues of corals, turning them white. After they bleach, these stressed corals either slowly regain their zooxanthellae and colour as temperatures cool off, or else they die.

The Great Barrier Reef bleached severely for the first time in 1998, then in 2002, and now again in 2016. This year's event was more extreme than the two previous mass bleachings. The dieback of corals due to bleaching in just 8-9 months is the largest loss ever recorded for the Great Barrier Reef.

To put these losses in context, over the 27 years from 1985 to 2012, scientists from the Australian Institute of Marine Science measured the gradual loss of 51% of corals on the central and southern regions of the Great Barrier Reef. This appears to be a consequence of storm damage, predation by the crown of thorns, bleaching and declining water quality. They reported no change over this extended period in the amount of corals in the remote, northern region.

Unfortunately, most of the losses in 2016 have occurred in this northern region of the reef. The process of recovery in the north – the replacement of dead corals by new ones – will be slow, possibly taking 10-15 years, as long as local conditions such as water quality remain

conducive to recovery. As global temperatures continue to climb recovery in the north may be hampered by further bleaching events.

Dead table corals killed by bleaching in the north, November 2016. Greg Torda, ARC Centre of Excellence for Coral Reef Studies

Coral reefs from the other side of the continent have also experienced unprecedented bleaching and coral death. This is surprising because the unique coral reefs of Western Australia's northwest are home to some of the toughest coral in the world.
Given the current warming trends, it is possible that Australia's reefs may never recover.

https://theconversation.com/how-much-coral-has-died-in-the-great-barrier-reefs-worst-bleaching-event-69494
https://theconversation.com/the-third-global-bleaching-event-took-its-toll-on-western-australias-super-corals-68146
http://www.aims.gov.au/docs/media/latest-releases/-/asset_publisher/8Kfw/content/2-october-2012-the-great-barrier-reef-has-lost-half-of-its-coral-in-the-last-27-years
http://www.gbrmpa.gov.au/managing-the-reef/threats-to-the-reef/declining-water-quality